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HQ USAF COMMAND POST DATA FLOW STUDY

T. A. Mackey
J. C. Penney

DECEMBER 1968

Prepared for

DIRECTORATE OF PLANNING AND TECHNOLOGY

ELECTRONIC SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
L. G. Hanscom Field, Bedford, Massachusetts

Project 512V
Prepared by
THE MITRE CORPORATION
Bedford, Massachusetts
Contract AF19(628)-5165

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FOREWORD

Contractor: The MITRE Corporation
Bedford, Massachusetts 01730

Contract Number: AF19(628)-5165

Air Force Contract Monitor: Charles L. Bruce, ESLFA

This study was conducted to analyze the communications data flow between the AUTODIN data transmission network and the Air Force Command Post command and control data system. The study was performed between 15 April 1968 and 15 July 1968.

REVIEW AND APPROVAL

This technical report has been reviewed and is approved.

WILLIAM F. HEISLER, COL, USAF
Chief, Command Systems Division
Directorate of Planning & Technology

ABSTRACT

The purpose of this study was to analyze the HQ USAF Command Post Communications data flow between the AUTODIN data transmission network and the Command Post data management system. This study was conducted in light of the phaseover from the IBM 1410 to the IBM 360/50. Alternative approaches for data flow improvements were considered and an overall plan is presented.

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SECTION I

INTRODUCTION

The purpose of this study was to analyze the HQ USAF Command Post Communications data flow between the AUTODIN data transmission network and the Command Post data management system. This study was conducted in light of the Command Post's current phaseover from the IBM 1410 to the IBM 360/50. Alternative approaches for data flow improvements were considered and an overall plan is presented.

The following sections of this paper will describe:

(a) AUTODIN as related to the Command Post data flow;
(b) Data Flow Components as a structuring of required functions;
(c) Current Operations in terms of the Data Flow Components;
(d) Card Traffic Projections;
(e) Goals for Command Post Command and Control Communications;
(f) Alternative Approaches for data flow improvements; and
(g) Plans and recommended actions.

SECTION II

AUTODIN

2.1 Background

AUTODIN is a network of subscriber stations, switching centers, and trunk lines which provide a telegraphic data transmission network for the Defense Communications System (DCS).

Data may be transferred by two methods: message switching or circuit switching. Message switching involves the use of the switching centers as temporary hold areas for messages which cannot be forwarded to the addressee immediately. Circuit switching involves the use of dedicated circuit lines from sender to receiver to provide a direct circuit between subscribers so that real-time data communication may occur.

Data sent via AUTODIN must be uniquely identified. To perform this identification, message header and trailer records are constructed, containing elements such as addressee identifier, record count, and data description. Upon reception of an AUTODIN message, a subscriber must separate, manually or via a computer program, the data images from the header and trailer images and forward the data to the facility computer system for data processing.

2.2 Terminals

Terminal (subscriber) equipment can be categorized into three equipment classes, which are known as the following:

High-Speed Card/Teletype Terminal (HSCTT);
Magnetic Tape Terminal (MTT); and
Computer Interface Terminal (CIT).

The HSCTT consists of a high-speed card reader/punch unit, a teletype unit, and a terminal control unit. Data is handled in punch card format and can be simultaneously sent or received. Data also may be sent or received via the teletype machine, but the normal flow is in card traffic.

The MTT consists of two magnetic tape units, a teleprinter, and a control unit. The control unit consists of an adaptor rack, a memory rack, a logic rack, and a control console. Data is transferred to or from the magnetic tape units, one of which acts as a send line and the other a receive line.

The CIT is a terminal unit which allows for direct data transfer to or from a computer system. This unit is connected directly to the AUTODIN line and to a data channel of a digital computer.

The above terminals have been considered in light of the Command Post requirements and not solely as communication devices. The current Command Post operation is via the card terminal, but either the magnetic tape terminal or the computer interface terminal is applicable for future operations.

2.3 Base Distribution

The Automatic Base Distribution System (ABCS) would, if implemented, consolidate AUTODIN traffic at one communications computer facility for each serviced location. Currently an AUTODIN subscriber is directly connected to one or more Automatic Electric Switching Centers (AESC's). Under the concept of the ABCS, each base would have a communications computer facility maintained by the Air Force Communications Service (AFCS). This computer facility would be directly connected to AESC's via the AUTODIN network. Each subscriber in turn would be connected to this computer via data lines and would only receive traffic addressed to him. The advantage of this system would be to minimize the number of AUTODIN lines into any one base (Figure 1).

Base Distribution would, if implemented, eliminate the necessity for subscribers such as the Command Post to perform message maintenance as specified in DCA Directive 370-175-1. This system would examine the message format and not the message content. It would still be the responsibility of the subscriber to process the data within AUTODIN messages.

LA-26,765

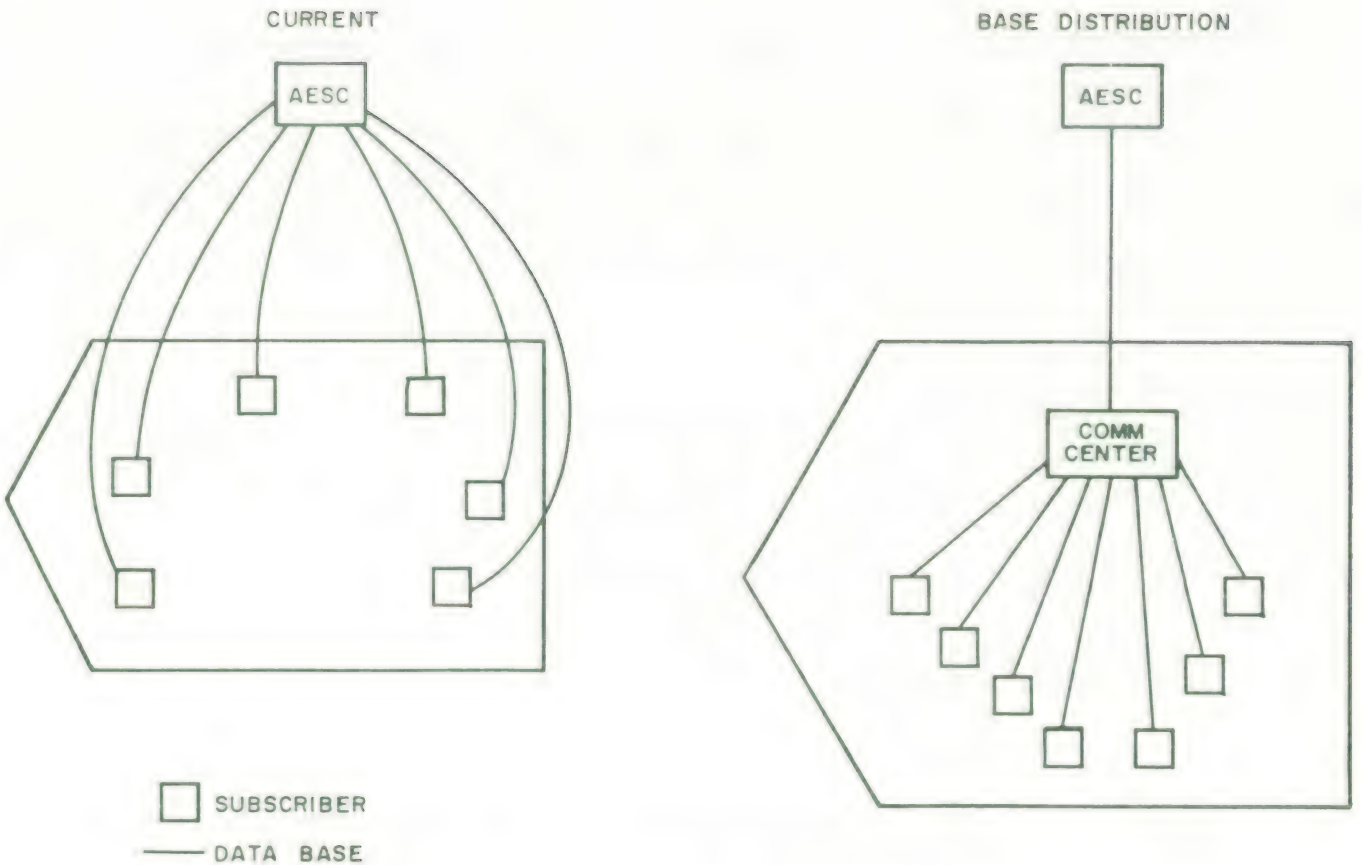


Figure 1 BASE DISTRIBUTION CONCEPT

SECTION III

DATA FLOW COMPONENTS

3.1 Introduction

The Command Post communications data flow can be structured into three segments. These segments are identified as:

(a) AUTODIN Control Functions;
(b) Data Handling Procedures; and
(c) CPU/Data Management System.

3.2 AUTODIN Control Functions

These functions are dictated by DCA directive 370-175-1 and must be performed by all AUTODIN terminals to ensure proper transmission. These functions include:

(a) Send (receive) message to (from) AUTODIN lines;
(b) Perform line edits to include character parity and line block parity;
(c) Acknowledge receipt of incoming data/accept acknowledgement for outgoing traffic; and
(d) Read (write) data to (from) I/O units.

3.3 Data Handling Procedures

These procedures involve the processing of both incoming and outgoing traffic.

3.3.1 Incoming Traffic

Message Handling

This function will perform the following:

(a) Log messages;
(b) Burst messages according to report; and
(c) Accumulate the message by line block.

Message Ordering

This function processes complete messages in the following manner:

(a) Order the message blocks;
(b) Strip communication control information;
(c) Separate digital data traffic from narratives; and
(d) Create files for digital data messages.

Data Editing

This function performs an input data audit on the message file and produces an error-exception report. In particular, this audit may perform:

(a) Field checks;
(b) Parameter range checks;
(c) Legal value comparisons;
(d) Simple data conversions; and
(e) Field interrelations.

Data Correction

This function will be operated only if data auditing errors occur. The analyst will prepare data corrections from information contained on the exception report. These corrections will be used directly to update the message files.

Data Formatting

This function will prepare message data for input to the CPU/Data Management System. The function will extract the data from the files and format this data for entry to the data management system.

3.3.2 Outgoing Traffic

This function will accept data and control parameters to build messages for AUTODIN transmission. AUTODIN formats and standard message data will be stored in a directory. In addition, message tracing will be performed.

3.4 CPU/Data Management System

This system must perform the following functions:

(a) Accept the output from the Data Handling Procedures (3.3);
(b) Relate the incoming data to the data base files; and
(c) Provide for correction of inconsistent data.

3.5 Summary

These components are presented in tabular format in Figure 2. The current Command Post operation will be described in terms of these components.

DATA FLOW COMPONENTS

AUTODIN CONTROL FUNCTIONS

Send (receive) message

Line Edits

- Character Parity
- Line Block Parity

Acknowledgement

Read (write) Data to (from) I/O Unit

DATA HANDLING PROCEDURES

Incoming

- Message Handling
  - Log
  - Burst
  - Hold
- Message Ordering
  - Sort
  - Strip
  - Store
- Data Editing
  - Field Check
  - Range Check
  - Legitimate Value Check
  - Simple Data Conversions
  - Field Interrelations
- Data Correction
  - Manual Intervention
  - Correct Erroneous Images
- Data Formatting
  - Retrieve by Report
  - Format Data for DMS FM
  - Output to Appropriate Medium

Outgoing

- Message Building
  - Data Card Input
  - Control Parameters
  - AUTODIN-Formatted Data

DATA MANAGEMENT SYSTEM

Component Interface Between DHP and DMS

- Format
- Medium

File Maintenance

- Complex Edits
- File Interrelations
  - Input Data
  - Data Base

Figure 2

SECTION IV

CURRENT CP AUTODIN OPERATION

4.1 Card Traffic

The Command Post AUTODIN terminal currently is a High Speed Card/Teletype Terminal connected directly to the Andrews AFB AESC. This terminal consists of the following:

(a) An IBM 1946 III Card Terminal;
(b) An IBM 1931 Card Reader/Punch; and
(c) An ASR Teletypewriter unit.

Colocated with this terminal is an IBM 548 Alphabetic Interpreter which is used to interpret (print on card) the data punched on cards. The 1946 communicates with the Andrews AESC at the rate of 1200 bits/second and the 1931 has a card transfer rate of 100 punch cards/minute. In other words, the 1931 can simultaneously punch cards or read cards, each at the rate of 100 cards/minute.

The Command Post terminal receives (transmits) card traffic to (from) reporting sites and other locations. Daily card traffic consists of about 70% receive and 30% send and has a volume of about 400,000 cards/month. This daily card traffic is mainly for the COACT, ALOREP, and FORCE STATUS data files (Figure 3).

The Command Post Card Terminal is operated 24 hours a day, 7 days a week and is manned by personnel whose normal function is the operation of the 1410 facility. Punched card incoming traffic is taken from the 1931 by the operator who interprets the cards using the 548. The operator then logs the message on a log sheet using data from the AUTODIN header card, discards the AUTODIN control cards, and forwards the deck for data processing by the CPU. The flow of the data from the AUTODIN terminal to final integration in the AFICCS data base is shown in Figure 4 for the major data files whose input is via AUTODIN card traffic. Card traffic to be sent via AUTODIN from the Command Post is manually prepared (i.e., the data cards and AUTODIN control cards are prepared and punched manually). This traffic is submitted to the terminal for subsequent transmission. It should be noted here that once the card traffic is processed, nearly all the cards are immediately destroyed.

4.2 Magnetic Tape Traffic

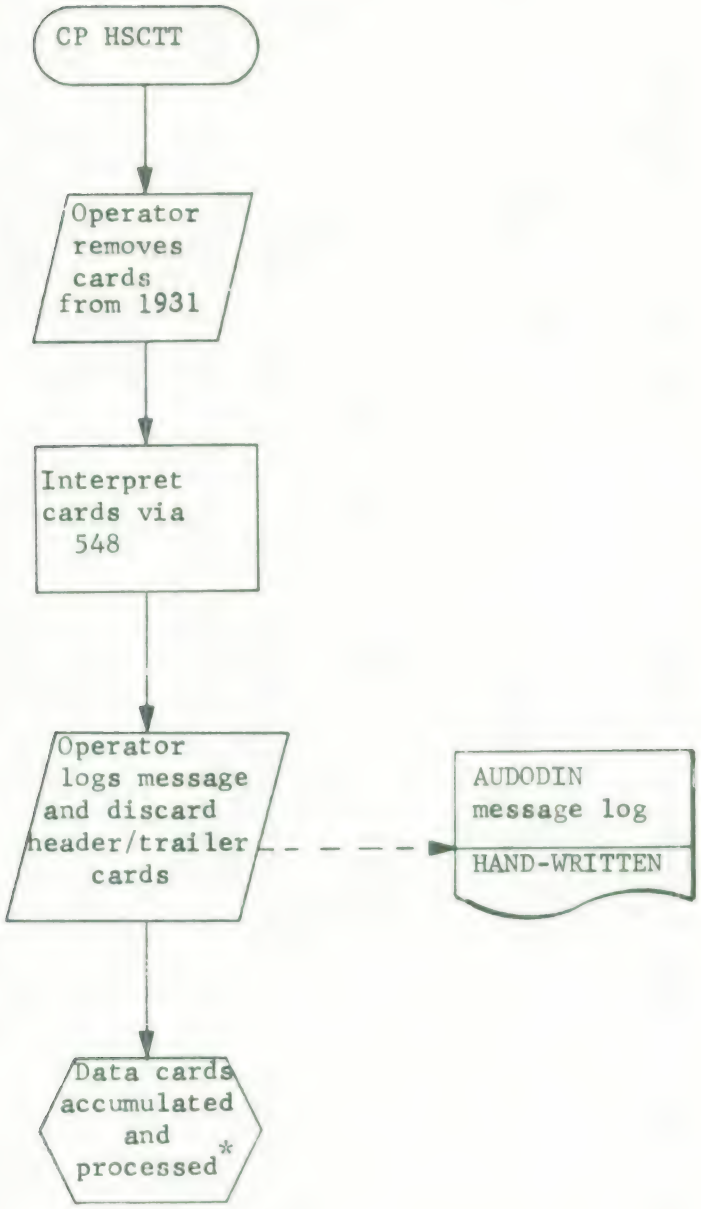
Magnetic tape traffic is received on a non-daily basis either through the U.S. Mail or via the Data Services Center Magnetic Tape Terminal in the Pentagon. The messages received on the tape terminal are logged and separated on individual tapes by processing the transcription tapes on an IBM 1401 computer.

When traffic is received for the Command Post, Data Services contacts the Command Post and notifies them of this traffic. Command Post personnel hand carry the data tape to the 1410 facility where it is duplicated and then the original tape is returned to Data Services. The duplicated tape is used as input to the file maintenance functions (Figure 5). Mailed tapes are received at the Command Post and are processed directly and returned to the originator.

4.3 Review

Figure 6 describes the AUTODIN card traffic flow at the Command Post in terms of the data handling components. The block style,  , indicates manual operation and rectangles indicate machine operations.

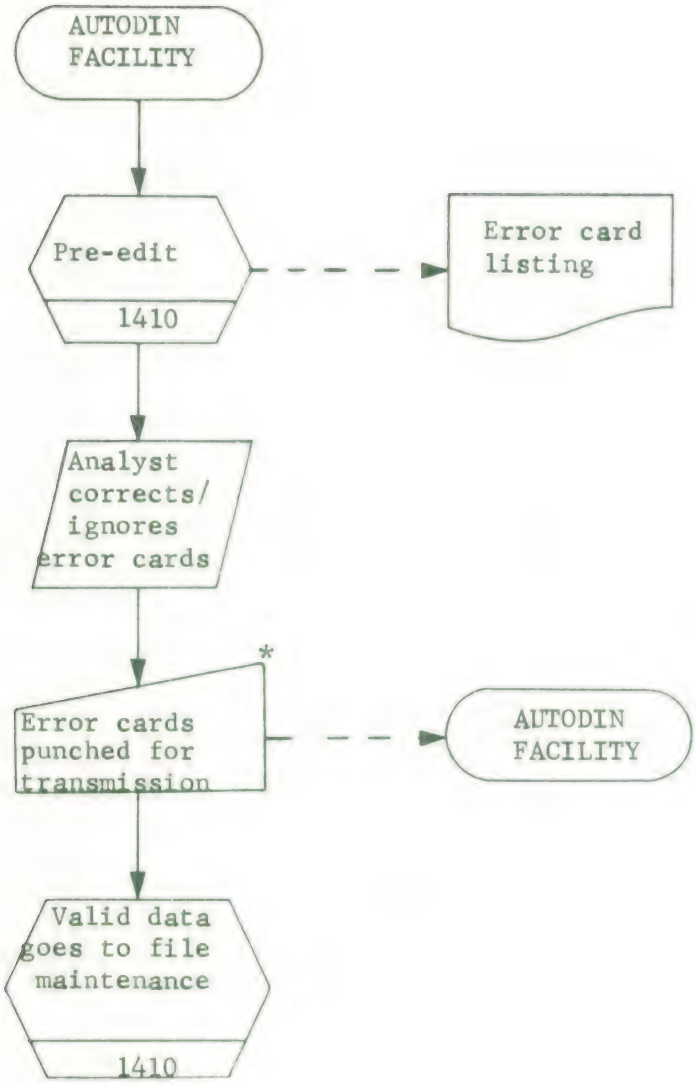
CARD TRAFFIC FLOW – RECEIVE



*Hand sort may be necessary.

Figure 3

FORCE STATUS DATA FLOW



*Only MAC error cards are prepared.

Figure 4

COACT DATA FLOW

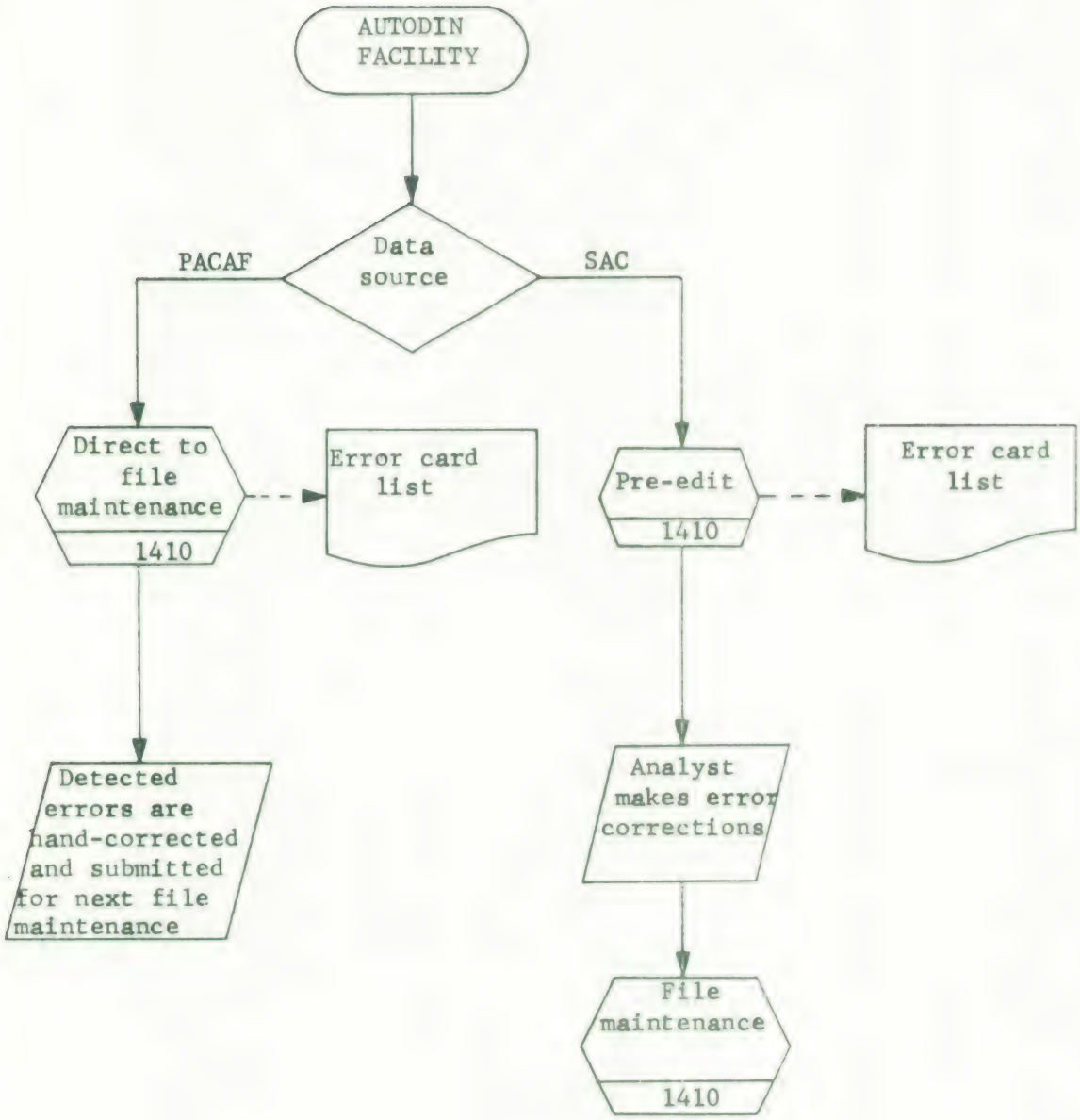


Figure 4 (Continued)

ALOREP DATA FLOW

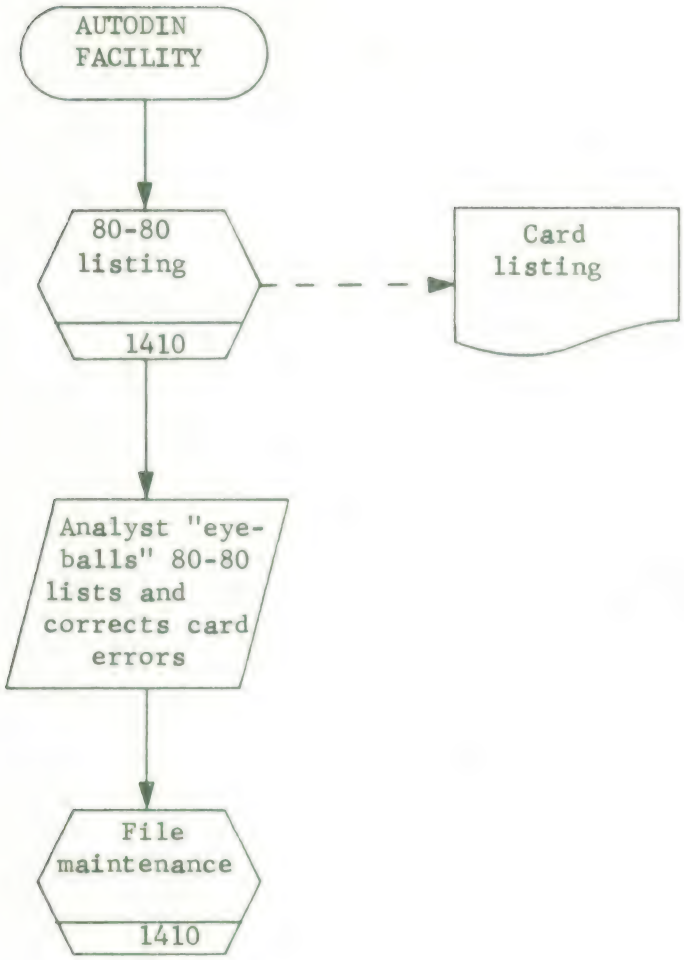


Figure 4 (Continued)

TAPE TRAFFIC FLOW VIA DATA SERVICES

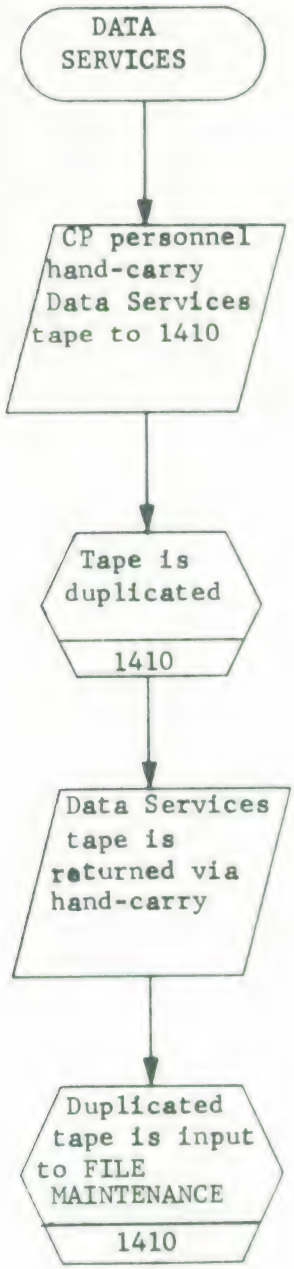


Figure 5

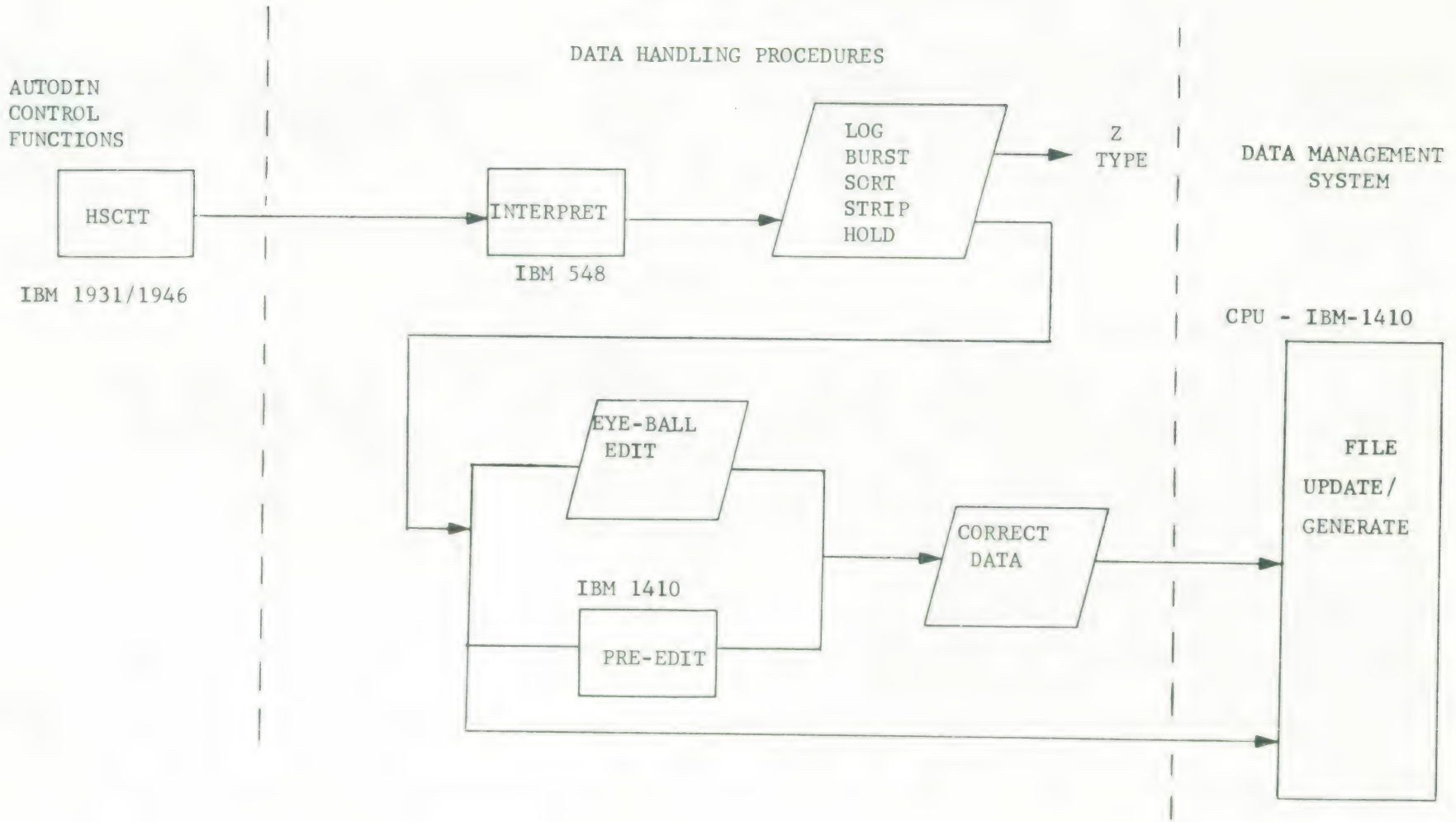

DATA HANDLING PROCEDURES
AUTODIN
CONTROL
FUNCTIONS
HSCTT
IBM 1931/1946
INTERPRET
IBM 548
LOG
BURST
SORT
STRIP
HOLD
Z
TYPE
DATA MANAGEMENT
SYSTEM
CPU - IBM-1410
EYE-BALL
EDIT
IBM 1410
PRE-EDIT
CORRECT
DATA
FILE
UPDATE/
GENERATE
- MANUAL TRANSPORTATION

Figure 6

SECTION V

PROJECTION OF CP AUTODIN CARD TRAFFIC

5.1 Discussion

This section presents the projection of AUTODIN card traffic at the AUTODIN terminal within the Command Post. This projection is based on data which was collected from the Data Control Branch of the Command Post Facility. The data represents:

(a) Volume by month for the calendar years 1966 and 1967;
(b) Volume by day during November 1966, and October 1967; and
(c) Volume by report type during October 1967, for PACAF, TAC, SAC, and USAFE.

Two graphs are presented in this section:

(a) Peak hour saturation (Figure 7); and
(b) Quarterly volume projection (Figure 8).

Both graphs represent similar geometric curves, but for presentation purposes, each have a different relative base. Essentially one curve is a proportional transformation of the other.

The Peak Hour Saturation graph is an extension of the Quarterly Volume Projection and is based on the formula:

$$S = \frac{1}{180} \left(\prod_{i=1}^{3} X_i \right) y$$

such that;

S = % of peak hour saturation;
y = quarterly volume;
x_1 = fraction of monthly received traffic in relation to all monthly traffic;
x_2 = fraction of monthly traffic on peak day;
x_3 = fraction of daily traffic during peak hour.

Figure 7 depicts the increasing percentage of saturation of the current Command Post AUTODIN terminal. For instance, 75% saturation will be achieved in the first quarter of 1970 and 90% saturation will occur in the final quarter of 1970.

Figure 8 represents the Quarterly Volume Projection and is based on the formula:

$$V = 130.027X^3 - 493.099X^2 + 127267.0X + 275926.3$$

This projection was performed using the IBM 7030 (STRETCH) computer. Actual data values which form the basis of the graphs in this section are presented in Appendix I.

5.2 Conclusions

This projection cannot be considered a basis for replacement of the card terminal. The peaking of traffic during the fourth hour (ZULU) on a Friday can be alleviated by balancing the transmission schedules. The lack of knowledge regarding unanticipated reporting applications for the AUTODIN system precludes the validity of any projection made at this time.

IA-26,766

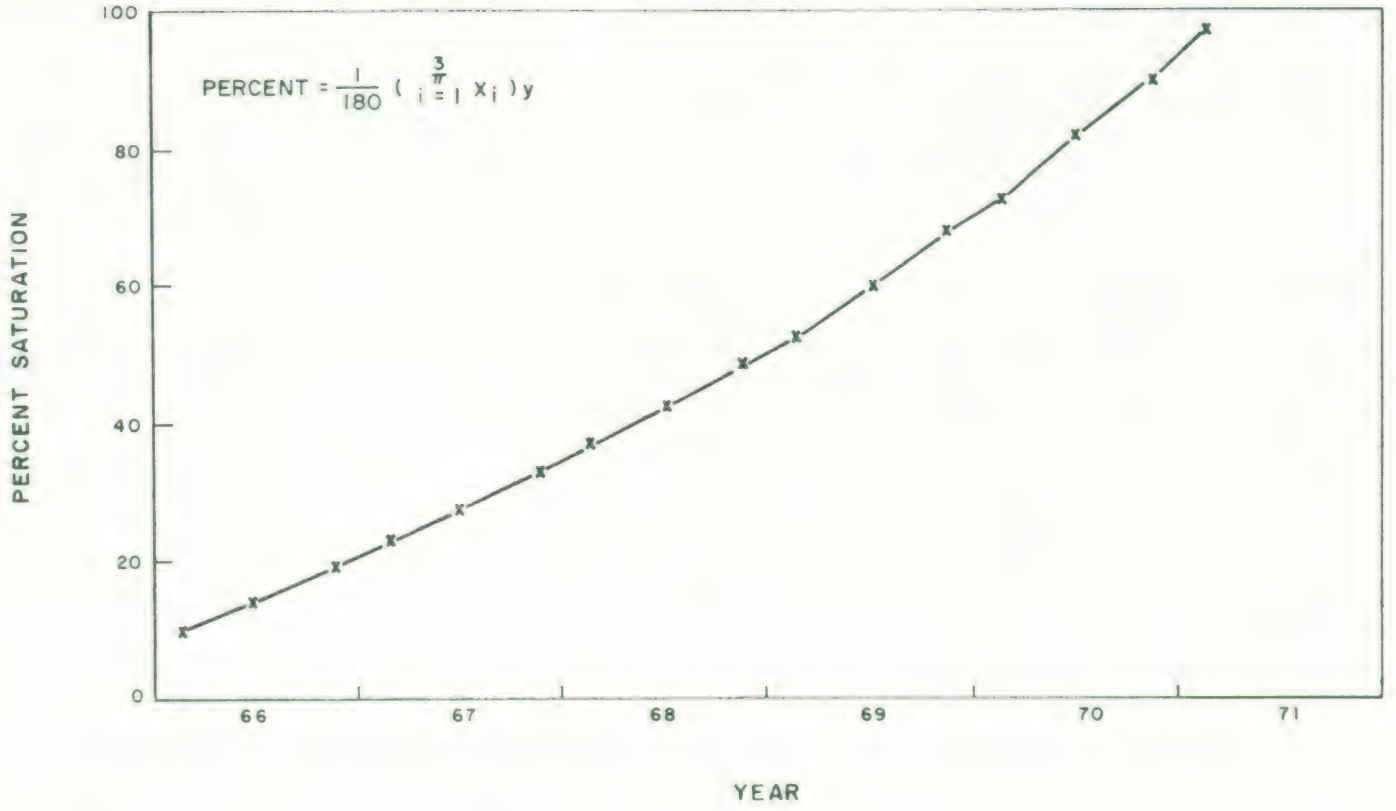


Figure 7 PEAK HOUR SATURATION

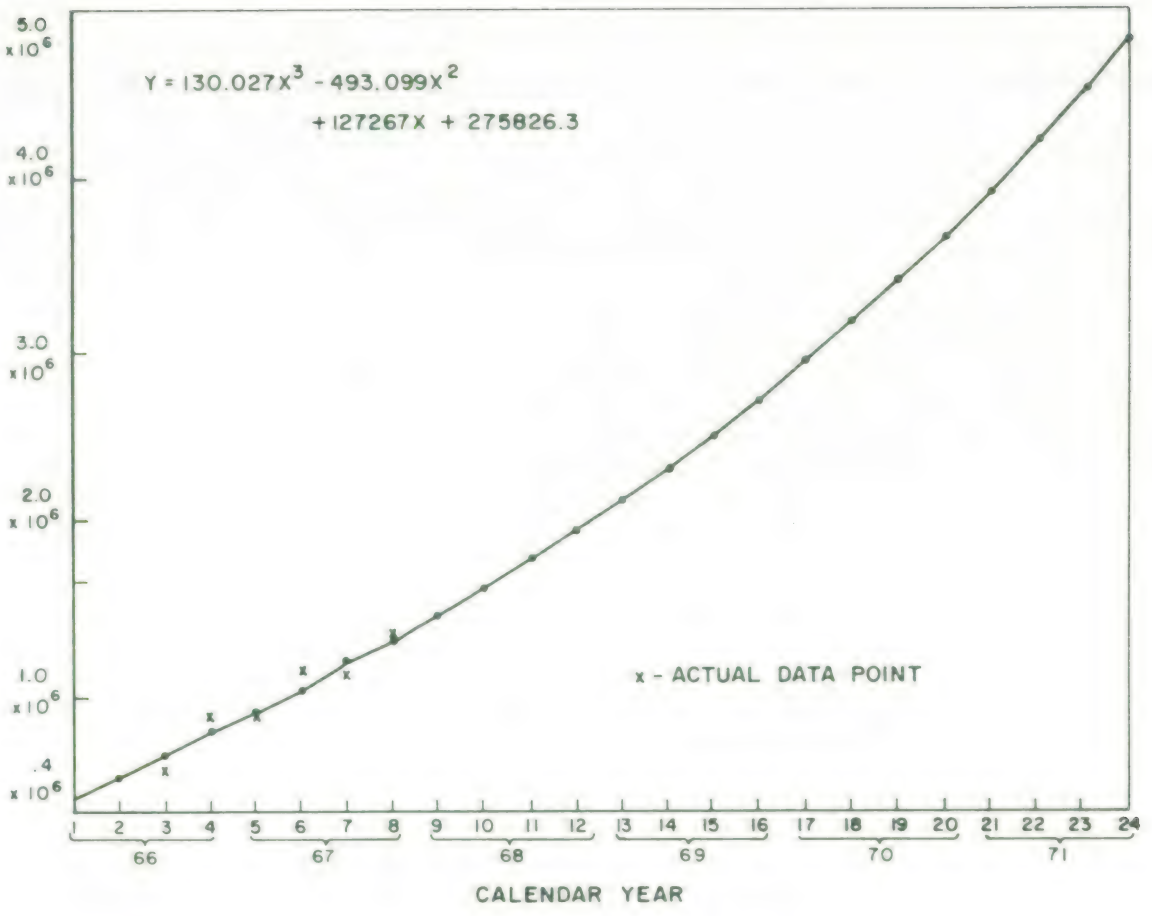


Figure 8 QUARTERLY VOLUME PROJECTION (CUBIC FUNCTION)

SECTION VI

GOALS

The preceding sections presented AUTODIN background information and current Command Post data flow. Any recommendations for improvements must be consistent with long-range goals. These goals must reflect known future requirements and technological concepts; and they include:

(a) Computer-to-computer exchange of information to permit rapid, automatic digital data transfer for improvement of Command and Control data base consistency;

(b) Remote access to the data base from inquiry stations to provide data base information to a wide range of Command and Control personnel; and

(c) Automation of source data to allow the timely entry into the data base of information pertinent to Command and Control.

The implications of these long-range goals include the necessity for a systems approach to message processing, the eventual elimination of manual handling, and the direct connection between the computer and the communications network. There exist areas where immediate action, consistent with the long-range goals, can be taken. These areas are:

(a) Reduction of data handling delays caused by manual handling and procedural deficiencies including separated data terminals;

(b) Standardization of message processing to permit automated processing whenever possible; and

(c) Consideration of eventual computer-to-computer communication which must be addressed at this time to ensure the future attainment of long-range goals.

The following sections present an overall plan which leads to the computer-to-computer information exchange as well as approaches and recommendations for immediate action.

SECTION VII

ALTERNATIVE APPROACHES AND NEAR-TERM RECOMMENDATION

The alternatives presented in this section were evaluated against the goals for near-term improvements (i.e., the reduction of data handling delays, the standardization of message processing, and the consideration of computer-to-computer exchange). An additional consideration for any near-term data flow improvement must be the CPU phaseover from the IBM 1410 to the IBM 360/50 which is currently in progress at the Command Post.

The alternatives which follow are identified by their hardware configuration as:

1 - COMPUTER INTERFACE TERMINAL DIRECT TO 360/50;

2 - COMPUTER INTERFACE TERMINAL WITH AN INTERMEDIATE DATA PROCESSOR (a small, general purpose, digital computer);

3 - MAGNETIC TAPE TERMINAL WITHOUT AN INTERMEDIATE DATA PROCESSOR;

4 - MAGNETIC TAPE TERMINAL WITH AN INTERMEDIATE DATA PROCESSOR; and

5 - HIGH SPEED CARD/TELETYPE TERMINAL.

COMPUTER INTERFACE TERMINAL DIRECT TO CENTRAL PROCESSING UNIT

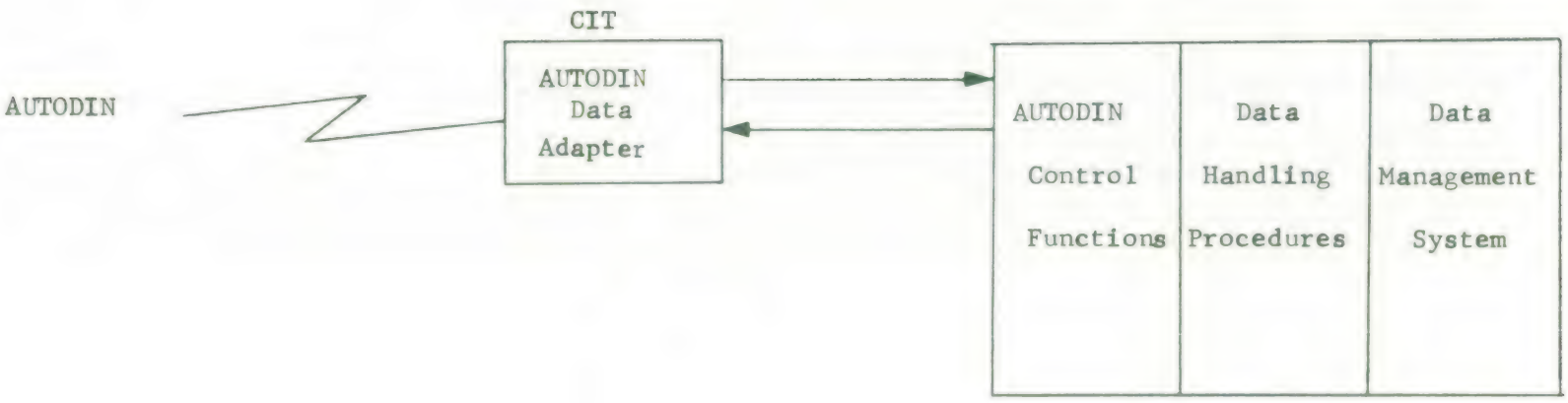


Figure 9

7.1 First Alternative

7.1.1 Computer Interface Terminal Direct to the 360/50

This alternative would permit the direct electrical connection of AUTODIN lines to the IBM 360/50 (Figure 9).

7.1.1.1 Hardware

An IBM 2701 AUTODIN adaptor unit (lease cost is $700/month) would replace the current card terminal and would connect AUTODIN lines to a data channel of the 360/50.

7.1.1.2 Software

Software must be developed in the 360/50 to execute the following elements:

(a) AUTODIN CONTROL FUNCTIONS;

(b) DATA HANDLING PROCEDURES;

(c) COMPONENT INTERFACE BETWEEN AUTODIN CONTROL FUNCTIONS AND DATA HANDLING PROCEDURES; and

(d) COMPONENT INTERFACE BETWEEN DATA HANDLING PROCEDURES AND DATA MANAGEMENT SYSTEM.

7.1.1.3 Discussion

This configuration permits direct data communication (i.e., computer-to-computer exchange) in a time-sharing environment. Time-sharing, however, is not sufficiently developed in both software and procedures to guarantee the continuous operation necessary for on-line operation. In addition, 360/50 software to process the AUTODIN Control Functions is not guaranteed by the manufacturer. The Data Management Systems which are being considered for use by the Command Post are not now operational. The phaseover to these systems will require much effort by the Command Post, and the additional burden of the development, checkout, and integration of software necessary for this alternative cannot be tolerated for immediate implementation.

COMPUTER INTERFACE TERMINAL WITH AN INTERMEDIATE DATA PROCESSOR

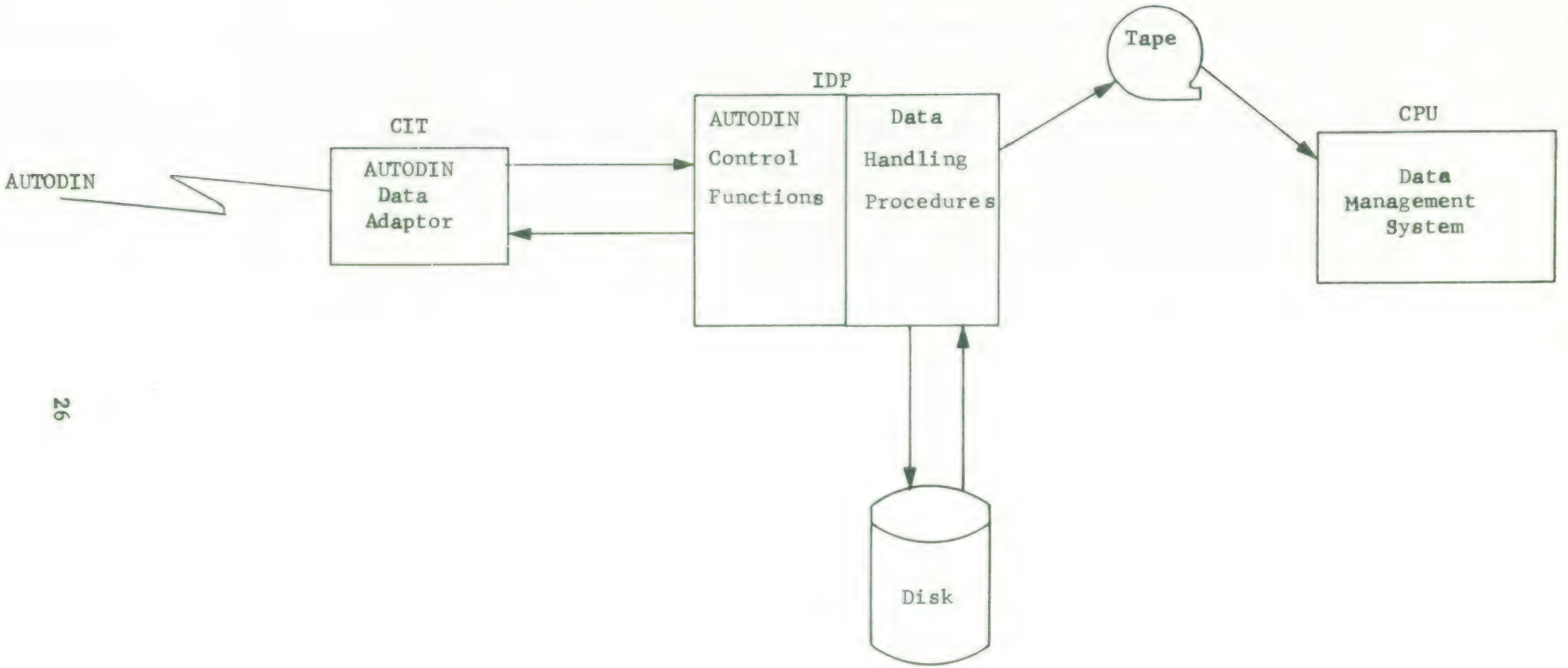


Figure 10

7.2 Second Alternative

7.2.1 Computer Interface Terminal With an Intermediate Data Processor

This alternative would permit the direct connection of the AUTODIN lines with a small, general purpose, digital computer. There would be no electrical connection between the Intermediate Data Processor and the 360/50 (see Figure 10). The Intermediate Data Processor would execute the AUTODIN Control Functions and the Data Handling Procedures.

7.2.1.1 Hardware

An Intermediate Data Processor and a compatible Computer Interface Terminal could be leased for $8,000 to $10,000 per month.

7.2.1.2 Software

The following components must be considered by any software development for the Intermediate Data Processor:

(a) AUTODIN CONTROL FUNCTIONS;

(b) DATA HANDLING PROCEDURES; and

(c) COMPONENT INTERFACE BETWEEN AUTODIN CONTROL FUNCTIONS AND DATA HANDLING PROCEDURES

7.2.1.3 Discussion

This alternative would not interfere directly with the current Command Post phaseover from the IBM 1410 to the IBM 360/50. The software development of the AUTODIN Control Functions would require checkout and acceptance in accordance with DCA Directives. Since criteria for evaluating Computer Interface Terminals have yet to be completely defined, this alternative should not be considered for near-term adoption.

MAGNETIC TAPE TERMINAL WITHOUT AN INTERMEDIATE DATA PROCESSOR

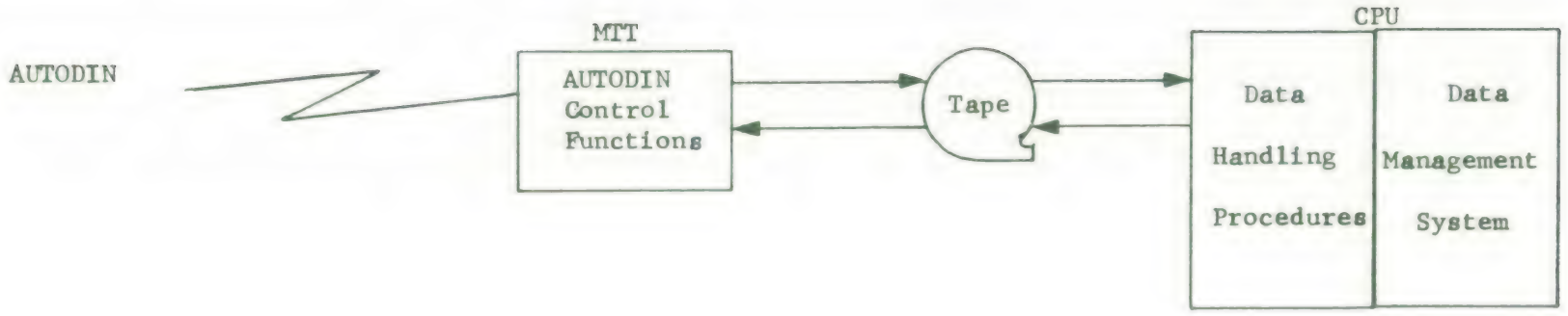


Figure 11

7.3 Third Alternative

7.3.1 A Magnetic Tape Terminal Without An Intermediate Data Processor

This alternative would consist of a Magnetic Tape Terminal with no electrical connection with the CPU. The terminal would execute the AUTODIN Control Functions and the CPU would execute the Data Handling Procedures and the Data Management System (Figure 11).

7.3.1.1 Hardware

The leasing of a Magnetic Tape Terminal would be required at a lease cost of $2,800 to $5,000 per month.

7.3.1.2 Software

Software development for CPU execution would be required for the following components:

(a) DATA HANDLING PROCEDURES; and

(b) COMPONENT INTERFACE BETWEEN DATA HANDLING PROCEDURES AND DATA MANAGEMENT SYSTEM.

7.3.1.3 Discussion

One advantage of this approach is the consolidation of all AUTODIN traffic at a sole terminal within the Command Post. AUTODIN Control Functions are provided with the terminal itself. However, the software development for the CPU would directly interfere with the current CPU phaseover.

MAGNETIC TAPE TERMINAL WITH AN INTERMEDIATE DATA PROCESSOR

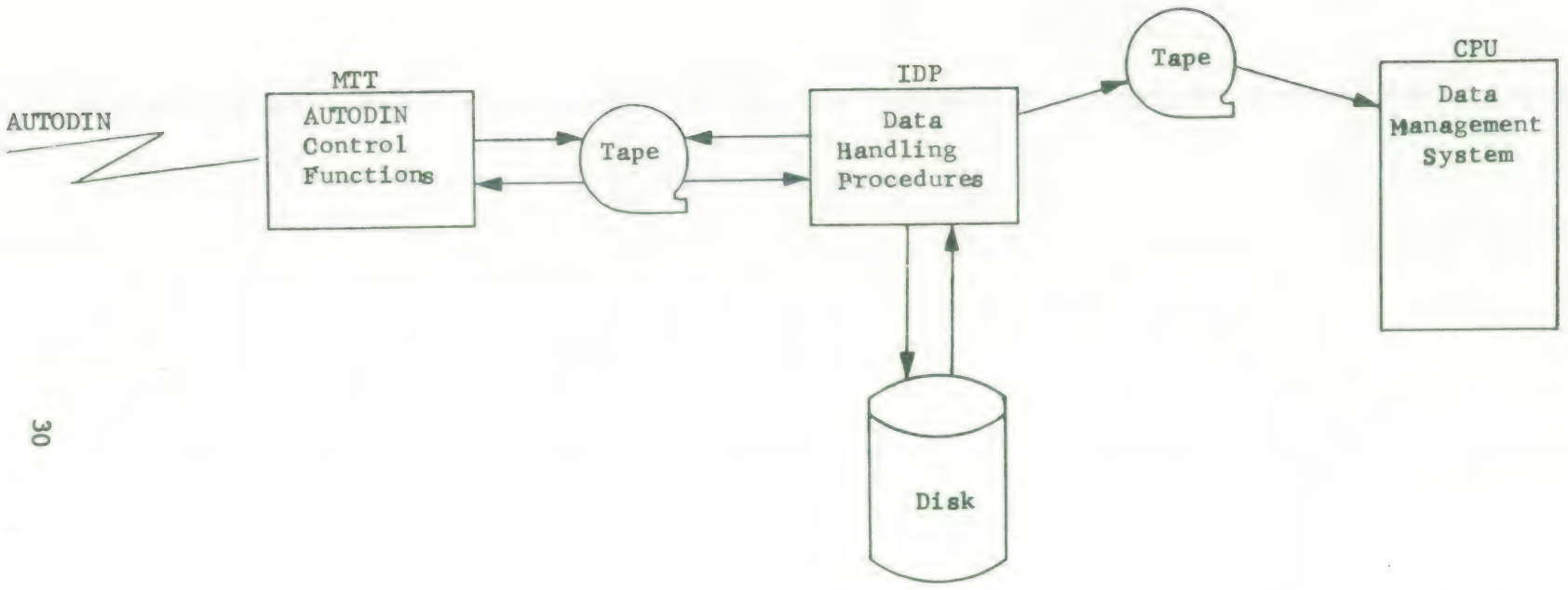


Figure 12

7.4 Fourth Alternative

7.4.1 A Magnetic Tape Terminal With An Intermediate Data Processor

This approach would consist of three unattached units. The Magnetic Tape Terminal would handle AUTODIN Control Functions. The Intermediate Data Processor would execute the Data Handling Procedures. The CPU would handle the Data Management System (Figure 12).

7.4.1.1 Hardware

A Magnetic Tape Terminal and an Intermediate Data Processor could be leased for $5,000 to $9,000 per month.

7.4.1.2 Software

The software development for the Intermediate Data Processor would be for the DATA HANDLING PROCEDURES only (refer to Section 3.3).

7.4.1.3 Discussion

This approach permits traffic consolidation within the Command Post and would not directly interfere with the current CPU phaseover. In addition, the software development can be completed in the near-term (six to eight calendar months).

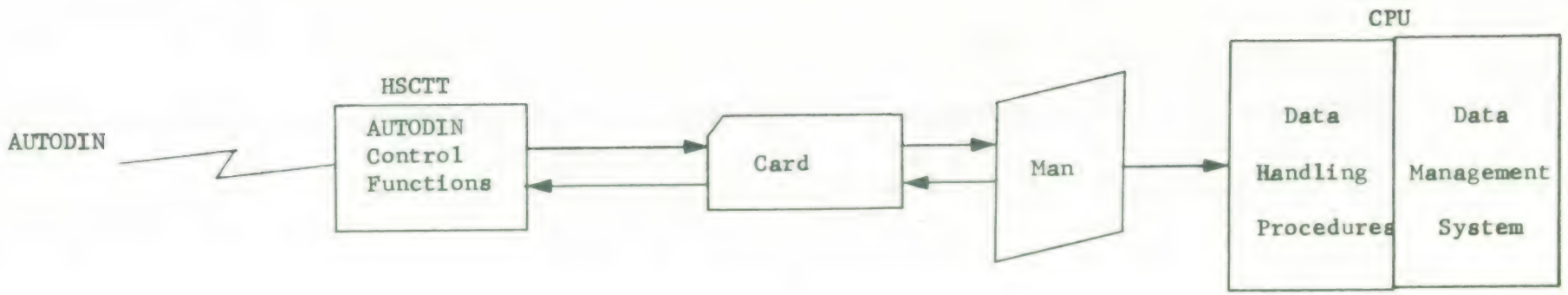

CPU
HSCTT
AUTODIN
AUTODIN
Control
Functions
Card
Man
Data
Handling
Procedures
Data
Management
System

Figure 13

7.5 Fifth Alternative

7.5.1 High Speed Card/Teletype Terminal

This approach would involve no hardware change but would require the improvement of current card handling procedures (Figure 13).

7.5.1.1 Hardware

No additional hardware would be required.

7.5.1.2 Software

A subset of the Data Handling Procedures, (i.e., the pre-edit functions) would be developed for the CPU.

7.5.1.3 Discussion

This alternative would have minimum impact on the current operations, but would not permit traffic consolidation within the Command Post.

7.6 Near-term Recommendation

It is recommended that the Command Post obtain a Magnetic Tape Terminal and an Intermediate Data Processor (Section 7.4.1). In addition, it is recommended that the Data Handling Procedures be implemented on the Intermediate Data Processor. Detailed information concerning hardware and software items is contained in Appendix II — Planning Considerations for the Near-Term Recommendation.

The present card terminal must be replaced by a Magnetic Tape Terminal in order to attain traffic consolidation within the Command Post and to reduce manual handling difficulties associated with cards. The employment of an Intermediate Data Processor aids in standardizing the message processing and avoids direct interference with the current phaseover from the IBM 1410 to the IBM 360/50.

This recommendation represents the first step towards computer-to-computer interchange of data. It is part of a coherent plan for system evolution which is described in the following section.

SECTION VIII

OVERALL PLAN AND RECOMMENDED ACTIONS

8.1 Overall Plan

This plan is an incremental approach to the computer-to-computer exchange of data (Figure 14). The plan consists of three stages which are sequenced in time and are dependent upon the Command Post operational development. Each stage is described in detail in the following subsections.

8.1.1 First Stage

(a) Hardware

This stage which is the near-term recommendation, consists of three electrically unattached units:

(i) A Magnetic Tape Terminal where the AUTODIN Control Functions are executed;
(ii) An Intermediate Data Processor where the Data Handling Procedures are executed; and
(iii) The IBM 360/50 where the Data Management System operates.

(b) Software

The Data Handling Procedures will be developed for the Intermediate Data Processor. The AUTODIN Control Functions are provided with the Magnetic Tape Terminal.

(c) Interfaces

The interfaces between the data flow components will be magnetic tape manually transported between units.

8.1.2 Second Stage

(a) Hardware

This stage consists of two electrically independent units:

(i) A Magnetic Tape Terminal where the AUTODIN Control Functions are executed; and

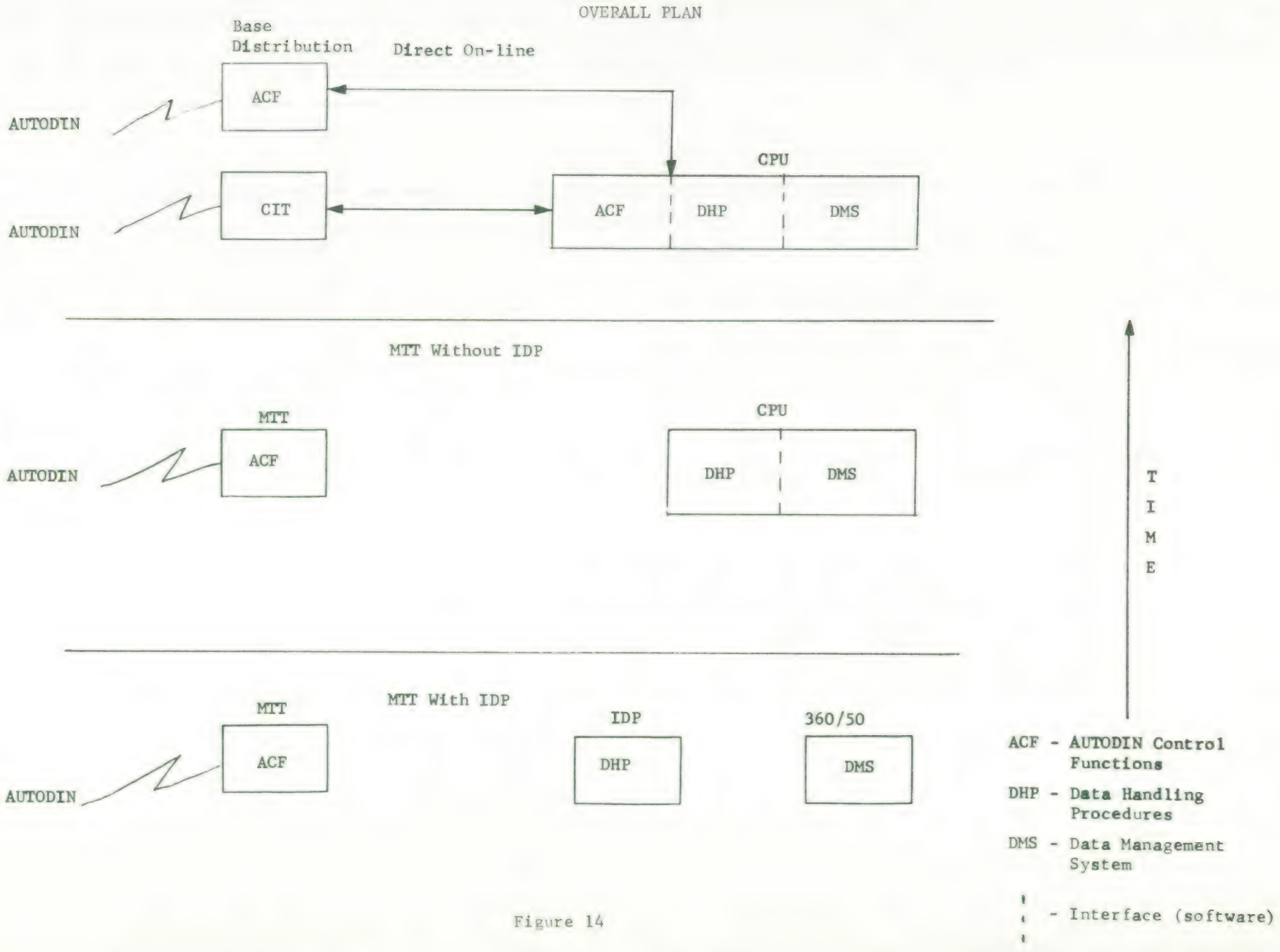

OVERALL PLAN
Base Distribution
Direct On-line
ACF
AUTODIN
CIT
AUTODIN
CPU
ACF
DHP
DMS
MTT Without IDP
MTT
ACF
AUTODIN
CPU
DHP
DMS
MTT With IDP
MTT
ACF
AUTODIN
IDP
DHP
360/50
DMS
TIME
ACF - AUTODIN Control Functions
DHP - Data Handling Procedures
DMS - Data Management System
- Interface (software)

Figure 14

(ii) The Central Processing Unit where both the Data Handling Procedures and the Data Management System are operated

(b) Software

The software development for this stage requires that the Data Handling Procedures and a software interface with the Data Management System be developed within the Central Processing Unit. The design logic employed in the first stage for the Data Handling Procedures will provide guidelines for this second stage development.

(c) Interfaces

The interface between the CPU and the AUTODIN terminal will be magnetic tape which will be manually transported.

8.1.3 Third Stage

(a) Hardware

This stage consists of two units, electrically attached:

(i) A Computer Interface Terminal which connects the AUTODIN lines and a data channel of the CPU; and
(ii) A Central Processing Unit where the three data flow components will be executed.

(b) Software

All three data flow components must be resident in the CPU. The AUTODIN Control Functions should be available (i.e., off-the-shelf) and could be obtained by Hq USAF.

(c) Interfaces

The component interfaces within the the CPU must be developed. There will be no manual interface operations within this stage.

(d) Base Distribution

In the event that Base Distribution becomes an operational reality, the Base Distribution Computer will perform the AUTODIN Control Functions and transmit the traffic to the CPU via a base data line. No Computer Interface Terminal within the Command Post would be required and the CPU would not execute the AUTODIN Control Functions.

8.2 Recommended Action

Immediate action should be taken in two areas: first, the steps required to implement the near-term recommendations and second, the consideration of a Communication Master Plan for the Command Post.

8.2.1 Near-Term Implementation

(a) Acquire a Magnetic Tape Terminal;
(b) Decide on a suitable Intermediate Data Processor and initiate action to acquire the particular unit;
(c) Initiate an in-depth analysis for the Command Post message flow for every report and message type;
(d) Define procedures necessary for operation of the Magnetic Tape Terminal/Intermediate Data Processor configuration. These procedures must include the following areas:

(i) Manual Operations;
(ii) Machine Operations;
(iii) Administrative Procedures to include training, scheduling, etc.

(e) Design and implement Intermediate Data Processor software modules to include:

(i) Data Handling Executive;
(ii) Data Auditing Routines; and
(iii) Message Preparation Routines.

(f) Prepare a detailed phaseover plan to include program testing, program, procedural documentation, and operational installation and checkout.

8.2.2 Communication Master Plan

This type of plan must be prepared, periodically reviewed, and, if necessary, adjusted to accommodate both technological and operational advances. This plan should provide an overall direction to the Command Post for any time within a five year period. Due to the requirements of the Command Post operations, a Communication Master Plan is a necessity to avoid undue confusion as new techniques and directives are developed. Flexibility to assume variable operational data loads and to profit by advanced technology must be fundamental to this plan.

The recommendations provided in this document are the first step of a Communication Master Plan.

APPENDIX I

PROJECTION RATIONALE

This appendix contains three graphs and four tables along with the underlying reasoning for determining peak hour saturation percentages. The graphs and tables, which represent the actual data values used, are the following:

(a) Graphic Volume by Quarter (Figure 15);
(b) Graphic Volume by Day (Figure 16);
(c) Graphic Volume by Hour (Figure 17);
(d) Tabular Volume ('66-'67) (Figure 18);
(e) Tabular Volume by Day (Figure 19);
(f) Tabular Volume by Hour (Figure 20); and
(g) Tabular Volume by Report (Figure 21).

Saturation for the card terminal is 6,000 cards per hour. The limit reflects the card equipment and not the AUTODIN transmission rate. Further, examination of the traffic volume revealed:

(a) The relation between incoming and outgoing traffic was 7 to 3.

(b) Friday was the peak day of the week and represented 6.98% of the monthly traffic.

(c) Between 0300Z and 0400Z, 9.22% of daily traffic was processed.

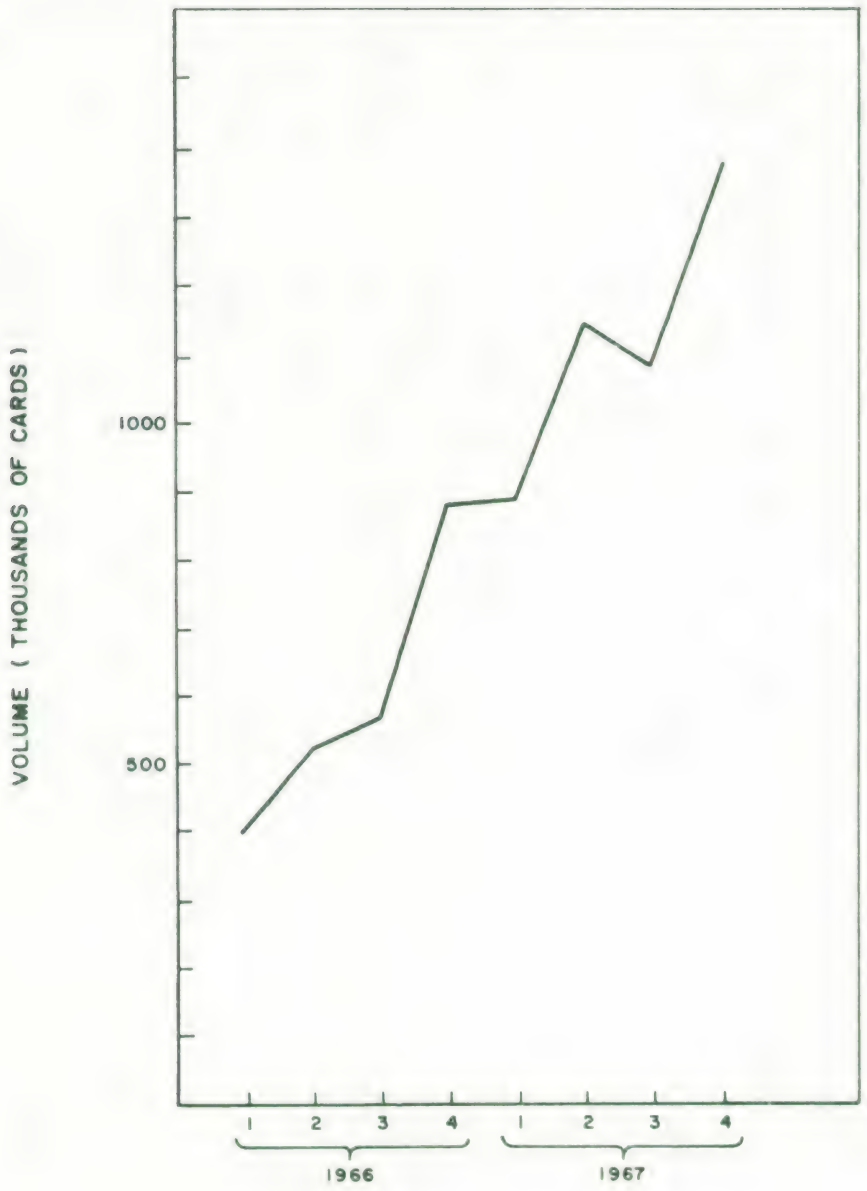
(d) Hence, multiplying the elements yields the fraction of incoming AUTODIN traffic during 0300Z-0400Z of any Friday; i.e.,

$$0.0922 \ \frac{\text{hourly}}{\text{daily}} \times 0.0698 \ \frac{\text{daily}}{\text{monthly}} \times 0.7 \ \frac{\text{received monthly}}{\text{received and sent monthly}} =$$

$$0.004504892 \ \frac{\text{received hourly}}{\text{received and sent monthly}}$$

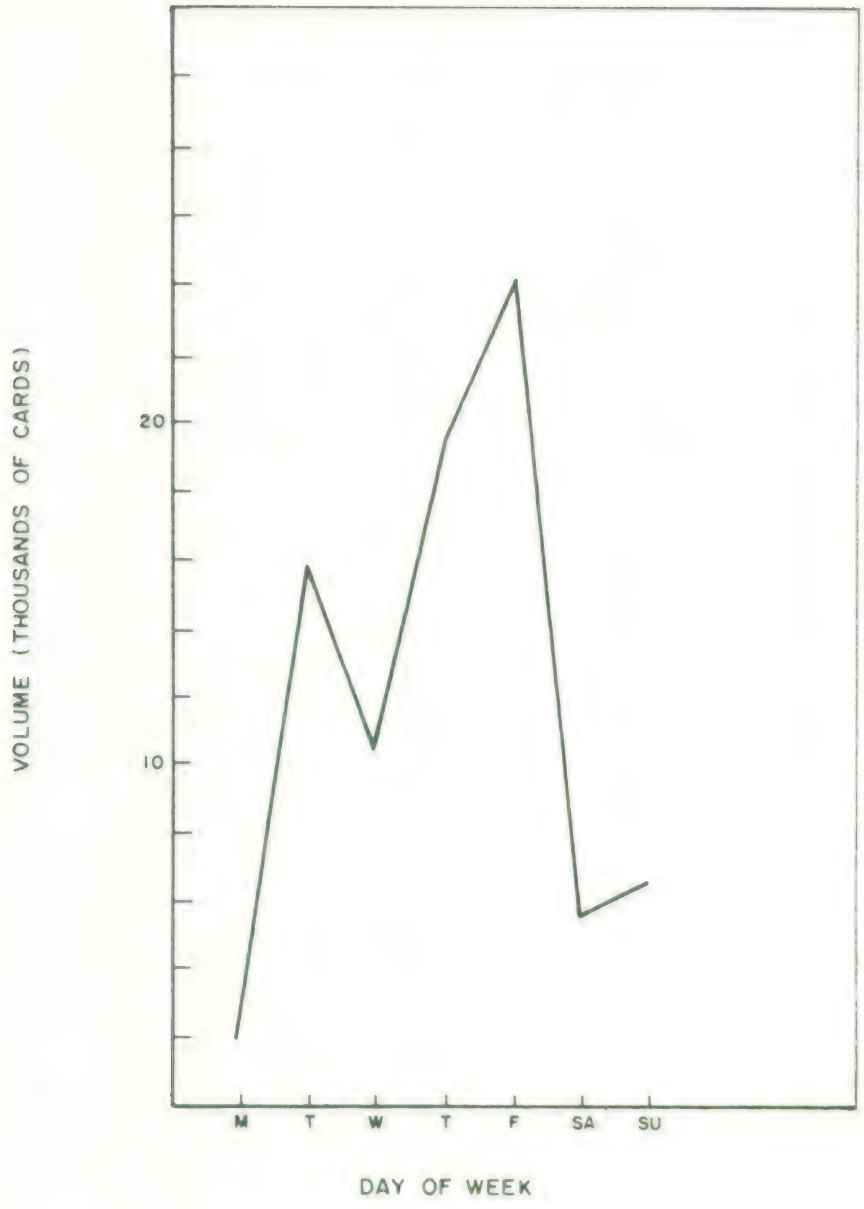
Thus, 0.45% of all monthly AUTODIN card traffic can be expected during the hour of 0300Z to 0400Z on any Friday.

Fundamental to the determination of the saturation curve, an estimated volume of quarterly traffic had to be obtained. The monthly data for 1966 and 1967 (Figure 18) was used as the basis of this projection. Based on the nature (finite differences) of the curve obtained by plotting this data, estimates were calculated for the projection. A curve fitting procedure was applied to the data points to produce polynominal fits. The cubic polynominal was chosen due to the fact that it most closely approximated the 1966-1967 data. The quarterly volumes were obtained from this derived projection polynominal.



IA-26,768

Figure 15 VOLUME BY QUARTER



IA - 26,769

Figure 16 VOLUME BY DAY (NOV/66)

IA-26,770

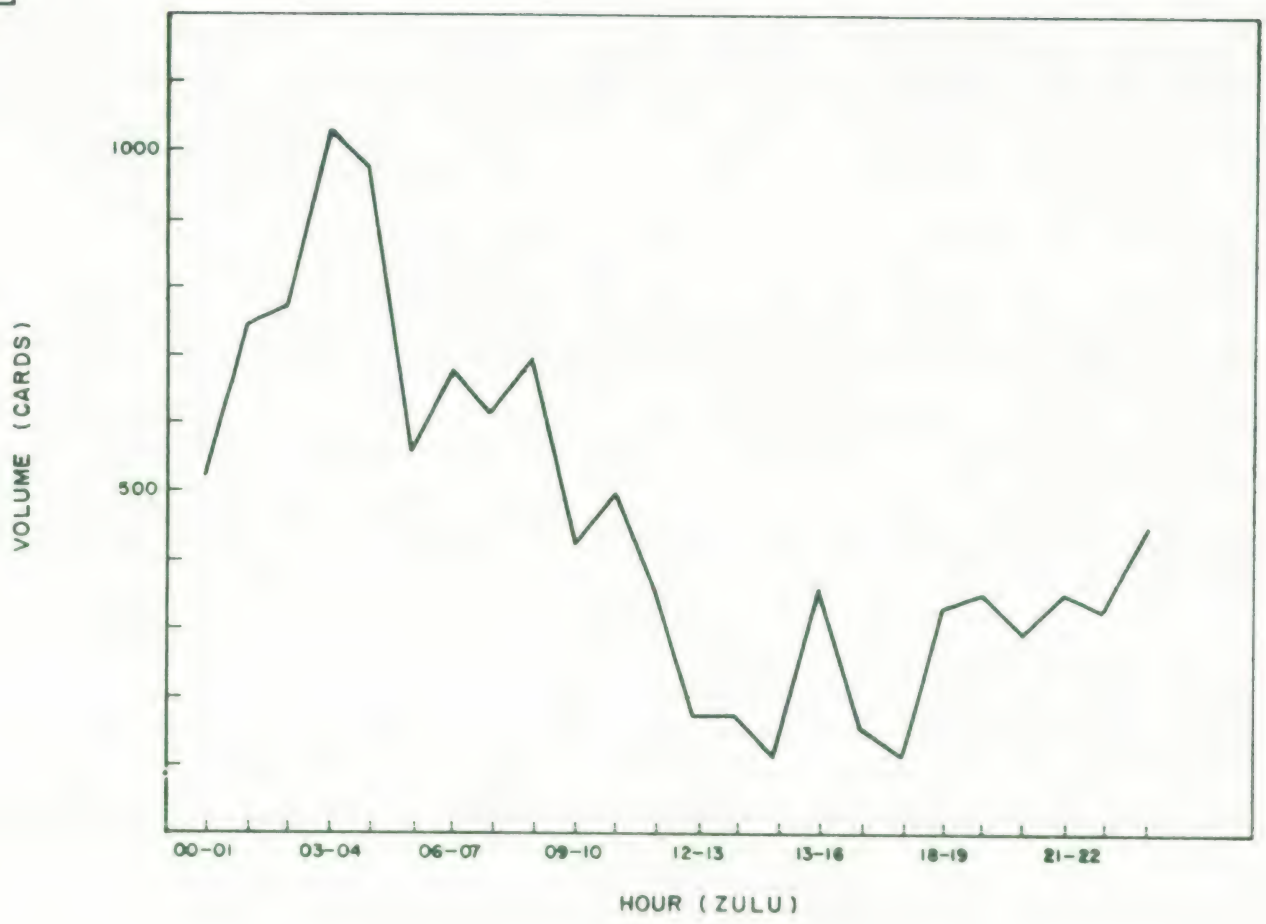


Figure 17 VOLUME BY HOUR (NOV/66)

VOLUME (1966-1967)

1966			1967		
MONTH	VOLUME		MONTH	VOLUME	
JANUARY	94452		JANUARY	267107	
FEBRUARY	114041	404966	FEBRUARY	264844	895631
MARCH	196503		MARCH	363680	
APRIL	161105		APRIL	385018	
MAY	155389	524027	MAY	366678	1147067
JUNE	207533		JUNE	395371	
JULY	175605		JULY	331405	
AUGUST	180482	567123	AUGUST	423350	1093102
SEPTEMBER	211036		SEPTEMBER	338347	
OCTOBER	251933		OCTOBER	467883	
NOVEMBER	330866	880737	NOVEMBER	449563	1376169
DECEMBER	297938		DECEMBER	458723	
ANNUAL TOTAL	2376883		ANNUAL TOTAL	4511969	

Figure 18

VOLUME BY DAY -- NOVEMBER 66

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
		15701	14699	18097	25423	23370
8323	2103	15943	10435	19429	24672	7372
1175	2640	6962	10799	13760	21553	12511
10474	3112	6245	10805	14341	5988	10752
3683	2123	7636	12252			

Figure 19

VOLUME BY HOUR – NOVEMBER 66

ZULU TIME

HOUR	VOLUME (Characters)
0001-0100	18724
0100-0200	22869
0200-0300	23092
0300-0400	31019
0400-0500	28909
0500-0600	16978
0600-0700	20013
0700-0800	18448
0800-0900	20825
0900-1000	12765
1000-1100	14862
1100-1200	10415
1200-1300	5639
1300-1400	5570
1400-1500	3361
1500-1600	11405
1500-1700	4416
1700-1800	4027
1800-1900	10056
1900-2000	10666
2000-2100	8953
2100-2200	10187
2200-2300	9840
2300-2400	13408

Figure 20

VOLUME BY REPORT (OCTOBER/1967)

REPORT	RECEIVE	SEND
Force Status	25,235	71,490
COACT	140,000	-
ALOREP	13,510	-
Miscellaneous	12,664	10,086
Total	191,409	81,576

This data applies only to the following commands:

PACAF
USAFE
TAC
SAC

Figure 21

APPENDIX II

PLANNING CONSIDERATIONS FOR THE NEAR-TERM RECOMMENDATION

This Appendix contains five sections which present detailed information regarding the implementation of the near-term recommendation.

(1) Magnetic Tape Terminals -- examples and lease charges;
(2) Intermediate Data Processor Components -- functional description;
(3) Intermediate Data Processors -- examples and lease charges;
(4) Typical Hardware Configurations -- comparative analysis with current configuration; and
(5) Software Schedule -- time and effort involved in implementing Data Handling Procedures on an Intermediate Data Processor.

1. Magnetic Tape Terminals

Several manufacturers can provide DCA-approved Magnetic Tape Terminal facilities. In addition to the hardware provided such as tape transport units, AUTODIN line adaptor, and logic units, the supplier provides DCA-acceptable program modules, board-wired or software-generated, to perform the AUTODIN Control Functions as specified by DCA Directive 370-175-1. The following examples meet DCA requirements and are presented with typical leasing charges.

DEVICE IDENTIFIER	LEASE CHARGE/MONTH
UNIVAC 1004 III	$2800
RCA Magnetic Tape Terminal	$4500
IBM Model 360/20 (AUTODIN Multi-Media Terminal)	$4500
UNIVAC SET 8	$9000

TYPICAL INTERMEDIATE DATA PROCESSOR CONFIGURATION

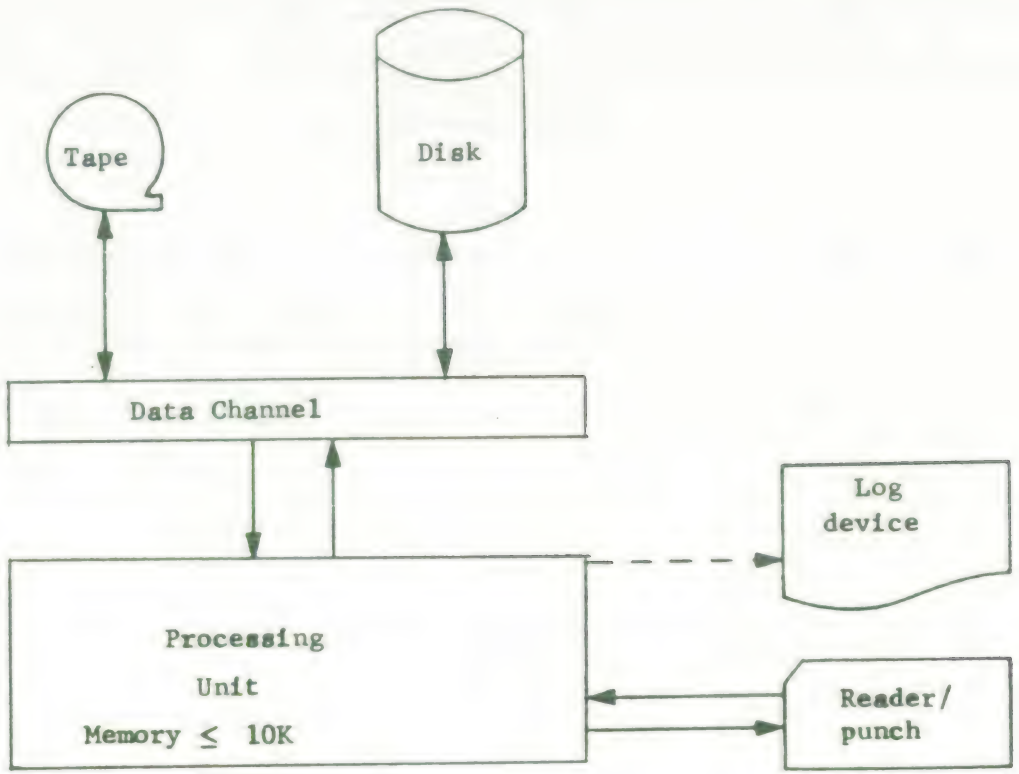


Figure 22

2. Intermediate Data Processor Components

The Intermediate Data Processor is a small, digital, general-purpose computer with magnetic tape and random access secondary storage. Core memory requirements can be small (i.e., less than 10,000 positions) since the simplicity of operations requires little direct storage. Other peripheral hardware necessary are a low-speed hard copy logging device for message logs and data error printouts and a low-speed card reader/punch to handle card input/output. Figure 22 presents a block hardware chart.

Magnetic Tape

The magnetic tape storage is required for communication with the AUTODIN tape terminal and the CPU. Incoming and outgoing AUTODIN data messages will be read from or written to the magnetic tapes of this processor. Properly formatted data for the CPU data management system will be written on a magnetic tape for manual transportation to the CPU.

Random Access Device

The random access device may be low-volume (e.g., disk pack). This storage device would be used for the following:

(a) Storage of the data handling software; and
(b) Storage of the accumulated message data.

Logging Device

The logging device will provide hard copy output for the message logs and data error reports. This device can be a typewriter or printer, but since this processor should perform its own compilations, a printer would be more realistic.

Card Reader/Punch

The card reader/punch will be used to accept both data correction cards and outgoing messages. If the assembler/compiler can direct its output to the disk, the punch would be unnecessary.

3. Intermediate Data Processors

The following processors satisfy the requirements for an Intermediate Data Processor and are presented with typical leasing charges.

DEVICE IDENTIFIER	LEASE CHARGE/MONTH
NCR 315	$2500
HONEYWELL 200/120	$3000
IBM MODEL 360/20	$3600
BURROUGHS 2500	$5000
RCA SPECTRA 70/25	$5200
IBM 1401	$6500

4. Typical Hardware Configurations

This section presents configurations which could replace the current terminal equipment. The examples presented here are used for cost comparisons only.

Current Configuration

The IBM 1946/1931 AUTODIN card terminal leases for approximately $2500 per month.

Typical Configurations

(a) The UNIVAC 1004 III Magnetic Tape Terminal plus an RCA Spectra 70/25 have a combined lease cost of approximately $8,000 per month ($2800 + $5200).

(b) The UNIVAC 1004 III Magnetic Tape Terminal plus the current IBM 1410 computer located in the Command Post have a combined lease cost of $2800/month. Although the lease charge of the Command Post IBM 1410 is about $20,000/month, the fact that it is there now and is financed independent of communication considerations makes this configuration desirable since the relative combined cost reflects the charge for the UNIVAC 1004 III alone (i.e., $2800). The IBM 1410 can perform as an Intermediate Data Processor if the following conditions hold true:

(1) The Command Post intends to retain the IBM 1410 for at least a calendar year; and

(2) The work load now on the 1410 will be gradually transferred to the 360/50 to make available 1410 computer time.

5. Software Schedule

The following time frame reflects a realistic plan for the design and implementation of the Data Handling Procedures for the Intermediate Data Processor:

(a) Design -- 2 men for 2 months;
(b) Implementation -- 3 men for 3 months; and
(c) Documentation and Installation -- 2 men for 2 months.

In summary, this task would require from 6 to 8 calendar months with about 17 to 20 man-months of effort.

BIBLIOGRAPHY

Computer Design Publishing Corporation, Computer Industry Annual 1967-1968, 1967.

Defense Communication Agency, DCA Circular 370-D175-1, DCS AUTODIN Interface and Control Criteria, October, 1967.

IBM Corporation, A22-6864-2, IBM 2701 Data Adaptor Unit - Component Description, July 1967.

Kuo, S.S., Numerical Methods and Computers, Addison-Wesley, 1965.

National Military Command System Support Center, CSM AM, 4A-66, Vol. I, NMCS Information Processing System File Maintenance, Structuring, and Revision, 15 March 1966.

Schwartz, J.I., TM 3628/001/00, Advanced Development Prototype, System Development Corporation, 30 January 1968.

Sobel, S.A., MTP-28-A, A Preliminary Cost/Effectiveness Comparison of Message and Circuit Switching in Military Communications Networks Servicing Record Traffic, The MITRE Corporation, June 1968.

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13. ABSTRACT

The purpose of this study was to analyze the HQ USAF Command Post Communications data flow between the AUTODIN data transmission network and the Command Post data management system. This study was conducted in light of the phaseover from the IBM 1410 to the IBM 360/50. Alternative approaches for data flow improvements were considered and an overall plan is presented.

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